DOCUMENT RESUME

ED 058 150 24 SP 005 354

AUTHOR Strandberg, Joel E.
TITLE Feedback Systems for Use with Paper-Based Instructional Products.
INSTITUTION Southwest Regional Educational Lab., Inglewood, Calif.
SPONS AGENCY National Center for Educational Research and Development (DHEW/OE), Washington, D.C.
REPORT NO SWRL-TR-10
BUREAU NO BR-6-2865
PUB DATE 14 Feb 69
NOTE 21p.

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS *Autoinstructional Aids; *Feedback; *Paper (Material); *Printing; *Programed Instruction

ABSTRACT

This survey describes 15 systems that provide feedback to students. Feedback is defined as information transfer from the instructional material to the student after a response is made by the student. The feedback is directed primarily to the student, but when a permanent record of the response occurs this information is also available to the instructor. Each system is reviewed with respect to 1) state of development, 2) production process, 3) reversibility or irreversibility, 4) cost of production, and 5) legal implications. The systems discussed are 1) mimeograph with water soluble dyes and water pens, 2) spirit duplication and chemical pens, 3) xerography with an erasable overlay, 4) letterpress with water soluble dyes and pens, 5) letter press using latent images and chemical pens, 6) letterpress with a scrapeable overlay, 7) letterpress with overprinting which is eliminated by a plastic reader, 8) letterpress or offset using electrically conductive inks and an electrically activated feedback, 9) letterpress or offset with a pressure-sensitive chemical feedback, 10) letterpress with latent images and overlay printing, 11) letterpress with erasable overlay, 12) letterpress or offset with magnetically activated feedback, 13) letterpress or offset with fluorescent activation of feedback, 14) letterpress or offset using absorbent white ink on white, and 15) letterpress with prepunched response forms. (MBM)

PERMISSION TO REPRODUCE THIS COPY RIGHTED MATERIAL HAS BEEN GRANTED BY
Joel E. Strandberg

TO ERIC AND ORGANIZATIONS OPERATING UNDER AGREEMENTS WITH THE U.S. OFFICE OF EDUCATION. FURTHER REPRODUCTION OUTSIDE THE ERIC SYSTEM REQUIRES PERMISSION OF THE COPYRIGHT OWNER.

© 1969 SOUTHWEST REGIONAL LABORATORY for Educational Research and Development, 11300 La Cienega Blvd., Inglewood, Calif., 90304
Published by Southwest Regional Laboratory for Educational Research and Development, a public agency supported as a regional educational laboratory by funds from the United States Office of Education, Department of Health, Education, and Welfare. The opinions expressed in this publication do not necessarily reflect the position or policy of the Office of Education, and no official endorsement by the Office of Education should be inferred.

ED058150

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY

FEEDBACK SYSTEMS FOR USE WITH PAPER-BASED INSTRUCTIONAL PRODUCTS

Joel E. Strandberg

This survey describes 15 systems that provide feedback to the student/instructor in the paper products domain. Feedback is defined as information transfer from the instructional material to the student after a response is made by the student. The information transfer occurs due to a chemical, electrical, mechanical, or optical reaction between some device that the student operates and the information on the paper. The feedback is directed primarily to the student. When a permanent record of the response occurs, a secondary purpose of the feedback is the transfer of information to the instructor.

For the feedback system to be feasible instructionally there can be no cues to the student which will cause him to attend to the feedback system without attending to the instructional stimuli. For example, when the cues related to differences between the right and wrong choices are obvious, the student quickly realizes that the payoff, both in time and in the number correct, is much higher if he attends to these cues rather than to the instructional stimulus. Other extraneous cues may result from differences in the weights of ink or positional differences due to multiple runs through printing equipment. The feedback systems described usually result in visual output. However, some

SP005354

additional step such as bending the paper or holding it at an angle to the light source to see the difference to reflectivity, may be required to produce the observation.

For the feedback system to be effective the reaction time must be rapid. Reaction time is defined as the time elapsing between the overt response of the student at the point of contact with the paper and the revelation of information to the student resulting from the reaction. The maximum reaction time for efficient learning is generally taken as one half of a second; though, an instantaneous reaction time is preferred.

For the feedback system to complete the information function the system reaction should be clearly visible to the student. While a common standard is not available, there should be sufficient contrast between the information and its background for the child to process the information at a glance. The progressive revelation of information due to the size of field or quantity of information may still fall within this criterion providing that the information processed by the student during each half-second will maintain his interest/motivation to continue responding.

Each system was reviewed with respect to several dimensions. The first dimension was the state of development, ranging from conception to production. Conception refers to verbal statements of an innovative system or first of a kind sample not under production control nor available in multiple quantities. A second state of development consists of laboratory prototypes. The prototypes are samples of a new process under production type controls. A third state of development, labeled in production, is applied to material printed in large scale quantities to commerical specifications or commercially available "off-the-shelf."

Secondly, the feedback system was analyzed with respect to the process by which it is produced. The choice of the process is related to the quantity of educational materials required. Instructional material development, by the classroom teacher or by the professional development institution, is facilitated by feedback systems adaptable to short run production. The order of magnitude of this production falls in the range of duplicating/copying and is identified by such equipment as the spirit duplicator, mimeograph, xerography and the offset printing press. Feedback systems adaptable to large production runs are required in the commerical production of text books and workbooks. Commercial printing is usually identified with letterpress or offset printing equipment processing sheets larger than 11 x 17 at one impression.

Thirdly, the feedback system was analyzed in relationship to reversibility or irreversibility of the feedback information. Reversibility relates to the state of the feedback information and its intrinsic ability to return to the original state after the information

is processed by the student. The reversibility may be a truly reversible chemical reaction in which an hour, or at most two, might be allowed for the return to the original state. It may also be a temporary visual translation due to electrical or optical means, so that the return to original state is instantaneous. Irreversibility of the feedback information relates to the permanency of the information as a result of the reaction. Irreversibility of information transfer finds its greatest usefulness in the answer forms of the examinations for record purposes. Reversibility of the information transfer results in reduced instructional material costs per student, because the material presumably could be used again and again.

Each feedback system was analyzed in terms of cost of production. Specific cost estimates were not attempted, rather the production steps or runs through specific equipment were enumerated.

Finally, the legal implications of the use of feedback systems was investigated. Some of the processes are in the open art of the printing industry and the successful reduction to production practice is a matter of trade skill and quality control. The remaining processes are proprietory and protected through patents. Some of these latter processes are probably open for use through licensing procedures. Contact names are provided for direct negotiation where applicable.

1. Mimeograph - Water Pens.

The technique of incorporating water soluble dyes in inks has been in the printing technology for sometime; however, the application to the mimeograph process was developed and tried out with success at the Arizona State University Classroom Learning Laboratory. The technique required three runs through the mimeograph. The stimulus material was applied on the first run. On the second run the correct response for each item was added in black mimeograph ink with a green water soluble dye suspended in the solution. The response image appeared in a black ink identical to the stimulus information. On the third run the incorrect response for each item was added in black mimeograph ink with a red water soluble dye in suspension. Again the incorrect response information appeared black identical to the previous runs. The student was given a fiber tipped pen filled with water. When the pen tip was applied to the response choice, the water on the tip reacted immediately with the black ink and the red or green color would appear.

The basic problem with the process appeared to be in the registration of information applied in successive runs on the mimeograph machine. Misregistration cued the student to the right response. Randomization of the placement of the responses reduced the cueing due to misregistration. A second major problem was that of equalizing the impression of information on the multiple stencils. If the stencils were not cut precisely equal, different inking rates would occur; hence, a difference

in the line weight of the printed copy would occur. Even machine made stencils did not reduce this cueing to zero. The water pens required non-toxic chemicals to be added to the water to reduce the bacterial growth in the pen barrels. This problem would not be difficult to overcome in the mass production of the pens.

Laboratory development of suitable inks was subsequently conducted by A. B. Dick Company, Chicago, Illinois in cooperation with the Southwest Regional Laboratory. However, the A. B. Dick Company made the decision not to market the inks. If further information is desired, it can be obtained by contacting Dr. Robert Wiper of the A. B. Dick Company, 5700 West Touhy Avenue, Chicago, Illinois. Telephone (312) 763-1900. Water filled pens can be procured from Paper Mate under the trade name of "Soft Touch." Mr. Leslie Hughes, Paper Mate Company, 444 Merchandise Mart, Chicago, Illinois, 60654, can provide further information. (See Figure 1.)

2. Spirit Duplication - Chemical Pens.

While working on the development of mimeograph inks for self-scoring, the A. B. Dick Company developed a feedback system for their spirit duplicator. This system consisted of a latent image being transfered to the page from a master. The latent image was revealed by using a chemical pen. Since the system is still undergoing prototype development and refinement, sample materials are not generally available. Making the master is analogous to making multi-color masters. The difference is that in addition to the basic color for the stimulus information, the response information is put on the original master by using a special amber-colored backup sheet. This transfers a latent image to the master that is invisible to the naked eye. Thus several problems intrinsic in the mimeograph process are eliminated. Specifically, only one master and one run through the machine is required. Cueing is eliminated in that no response information is visible. However, one problem appeared in early samples. The reaction time of the chemicals required a second or more before visible images appeared, but this reaction time has since been reduced. A related problem was the weakness of the visible image after the reaction; however, this too, has been made darker. Duplication runs of 75-100 from one master are possible. The system components, special latent image masters and chemical pens, are protected by patents in process by A. B. Dick Company. (See Figure 2.)

Information concerning availability of production masters and chemical pens can be obtained from Dr. Robert Wiper, A. B. Dick Company, 5700 West Touhy Avenue, Chicago, Illinois. Telephone (312) 763-1900.

3. Xerography - Eraseable Overlay.

Xerography provides an interesting solution to the utilization of self-scoring techniques in the development of materials. The process

requires two runs through the machine. The first run transfers all of the stimulus material and the response material to the paper and it is hardened in the normal manner. The second run consists of overlaying the response information with a coat of carbon toner either in a solid or disguised manner. However, in the second run the hardening lamp is disconnected by activating a switch. This results in the deposited carbon being erasable. Standard pencil erasers remove the overlay toner quite easily. Cueing can be a problem if randomization of overlay techniques are not incorporated. However, the system is quite flexible. The overlay can be applied anywhere on the entire page such as in maps where labels for capitals, countries or river names, etc. are overlayed or alternative boundaries or symbols are deposited.

This system was conceived and developed by Stanley Wolf while he was at Xerox Corporation (600 Madison Avenue, New York, New York, 10022 [212] 935-7600). It is applicable to any Xerography machine such as the Xerox 2400. Ownership of the equipment should be established or permission obtained from Xerox before any modification of leased equipment is attempted. Most Xerography machines can be modified by an electrician. The system is quite inexpensive for short run production.

4. Letterpress - Water Pens.

The letterpress printing process is an effective high production solution for providing self-scoring. The letterpress inks are insoluble in water; hence, the suspension of water soluble dyes is no problem. Furthermore, the letterpress registration and ink control produces copy beyond the ability of any student to perceive differences due to different runs. One production example is an answer form printed by Educational Aids Publishing Corp., Carle Place, New York. In this form of one hundred multiple-choice responses printed in black ink the correct responses contain a green water soluble dye and the incorrect responses contain a red water soluble dye. When a fiber tipped pen containing water is applied to the letter representing the response choice, the dye suspended in the ink dissolves revealing either a red or green color. The chemical reaction time is very fast and it is impossible to cheat. The color reacts immediately even to the lightest touch showing an answer attempt has been made. The response choice is by no means limited to multiple-choice type responses. The technique could be applied to various kinds of line work anywhere on the page, i.e., as map information: multiple boundaries, capitals vs. key cities, symbols, etc.

This process cannot be adapted directly to offset printing due to the combination of water/ink founts used in the printing process. The water soluble dyes in the ink would bleed in the printing founts. For information on the standard forms mentioned above contact Mr. Phillip DeVon, Educational Aids Publishing Corp., Carle Place, Long Island, New York. Telephone (212) 343-5151. Specially prepared examination forms can be produced; however, due to the high set-up costs, production

quantities running in tens of thousands are required to make the sheets economically profitable i.e., down to pennies per sheet. Water filled pens can be procured from Paper Mate under the trade name of "Soft Touch." Contact Mr. Leslie Hughes, Paper Mate Company, 444 Merchandise Mart, Chicago, Illinois, 60654, for further information.

This process was used by Central Scientific Company on training materials under the name "Color Tutor" and by Appleton-Century-Croft on a psychology workbook several years ago. (See Figure 3.)

5. Letterpress - Chemical Pens.

Several publications have been marketed utilizing a latent image for student responses printed on letterpresses and on offset presses. These latent images on the coated paper are activated by drawing or writing with a chemical pen. When the correct response is made the latent image will usually turn gray. Again the same problems are intrinsic in this process that are in the spirit duplication latent image process. When the process is not closely inspected in production, the latent image area will become discernable and cue the student where to respond. Conversely, where not discernable, the latent coating may be so weak that the reaction time is delayed or does not occur. When the printing process is correct, the latent images are not visible. The response area, when activated with the chemical pen, becomes a light gray and it is sufficiently discernable to give feedback. The response time seems to be satisfactory on the production samples tested. As can be seen in the published material references below, the process can be applied anywhere on the page giving a wide latitude to the developers of both concept development as well as motor skill development materials. The latent imaging process offers certain constructed response patterns not available in other systems; specifically, instruction material providing immediate feedback to the child printing/writing the letter or word correctly. The chemical pens are usually developed to be compatible only for the particular ink used by the publisher; hence, the publisher also markets the pens.

Material utilizing this process is published by Lyons and Carnahan in the Write and See series, by Appleton-Century-Croft (contact Mr. Walther [212] 689-5700) and by McGraw-Webster in the Sullivan programmed reading series. Braden-Sutphin Ink Co., 3650 East 93rd Street, Cleveland, Ohio, has a combination of ink and chemical, Z-706 and Z-707, respectively, that can be applied by specialty printers.

6. Letterpress - Scrapeable Overlay.

A novel approach in providing feedback has been perfected by EVCO, Alberquerque, New Mexico. In this solution the response information is printed in red on an IBM card containing 24 multiple choice items with

four choices each. A varnish coat is applied and then an overlay coat of black ink is printed in an array of quarter inch squares over the correct and incorrect response information. Two additional features are incorporated in this system. The feedback may present instructional information such as a numerical answer. Secondly, the card is in a machine scorable format. The device used to scrape off the overlay coating is made of plastic and is called a "Truthpic." The process is irreversible and the overlay resists erasure.

For further information contact Dr. James L. Evans, EVCO Basic Instructional Research and Design, Division of Dorsett Educational Systems, 225 San Pedro N.E., Alberquerque, New Mexico. Telephone (505) 255-9811. (See Figure 4.)

7. Letterpress - Overprinting Eliminated by Plastic Reader.

A technique adapted from promotional contest advertising utilizes colored transparent plastic to eliminate overprinting in the same color as the plastic. The process requires two printing runs on either letterpress or offset equipment. The first printing applies the stimulus information and the feedback information related to each response choice. The second printing run applies some design such as squiggle lines placed very close to one another over the feedback information in a bright color different from the first color used. A piece of transparent plastic colored with the same bright color as the overlay printing will transmit only the original color printed. The colors used are usually black for the first run for the stimulus and response information and a bright red for the overlay printing in the response area. The student is told to place the transparent plastic over the response area to read the feedback information. The advantage is that considerable text can be transmitted in the feedback area. The main disadvantage is that the student can learn to discriminate the original color from the overprinting and will not require the plastic after a short time, especially if the answer is short. The system is reusable by more than one student since the student's response does not permanently change the state of the response area. In production runs the cost is low, approximately the price of two-color printing.

Representative samples of the technique applied to programmed instruction can be obtained from Litton Industries, Education Division, Beverly Hills, California. Specialty printers can readily produce the overlay to match any colored plastic reader chosen. (See Figure 5.)

8. Letterpress/Offset - Electrically Activated Feedback.

The need for methods of providing feedback that do not destroy material requiring student response exists across the material development field. One solution that is ready for production application is

offered by EVCO. It consists of letterpressing electrically conductive inks to the printed page in correct response positions, identical in appearance to non-conductive inks used in incorrect response positions. The student holds in his hand a unit similar to a pencil flashlight called a "Tutor-Pen." The end of this unit has a contact point within a contact ring. When the contact end is on the conductive ink, the circuit is completed and a light becomes visible to the student. This unit has a rapid response time and positive action. There is a question as to the number of times the page can be reused in that at the present state of the art the conductive ink shows a slight mark (slight scrape and slight indentation) that could cue the next user to choices made by previous users. It is conceivable that the quality of the conductive inks and card stock or the sensitivity of the electrical contacts could be improved.

For further information contact Dr. James L. Evans, EVCO Basic Instructional Research and Design, Division of Dorsett Educational Systems, 225 San Pedro N.E., Alberquerque, New Mexico, 87108. (See Figure 6.)

9. Letterpress/Offset - Pressure Sensitive Chemical Feedback.

Paper technologists of several companies producing pressure sensitive chemical coatings have attempted to apply the process to feedback systems. Although there is no product on the market to date, one system holds promise. In this system the stimulus material with the response choice is printed on a chemically impregnated paper. The interactive chemical is selectively deposited at the correct response choice as particles suspended in the ink. Thus, a chemical reaction takes place when the student makes a response. The response consists of making a pressure stroke with the blunt end of a writing instrument. Ideally a two-color system would be most desirable. In this system the material is not reusable.

For further information contact Dr. Dean Ostlie, Minnesota Mining and Manufacturing Company, Paper Products Division, 2500 East Hudson Road, St. Paul, Minnesota.

10. Letterpress - Overlay Printing.

Another application of an overlay printing technique uses abrasive material suspended in the ink solution of one of the two runs. The first run deposits a basic background color such as white on the paper. After the stimulus information has been laid down in a contrast color, a second latent image run is made with the white ink in which an abrasive material is suspended.

To bring out the latent image, a soft lead pencil is rubbed over the response area of the page. This rubbing action causes the abrasive

material to retain a great deal more pencil lead than the area printed in plain white. The latent image containing the abrasive material becomes visible due to the contrast of black to the light gray background.

The process is relatively inexpensive in that it can be applied on letterpress or even on offset printing equipment. The limitations of its use in instruction is the cueing of the correct response by the slight difference in reflectivity of light between the white ink with the abrasive and plain white ink. If this difference of reflectivity can be reduced to zero, then this would be a suitable technique for self-scoring applications. The process is irreversible such that once the latent image is revealed, it can not be returned to the initial state.

One can find applications of this technique on such devices as Post Cereal boxes, children's playbooks and puzzle books, etc. For information on the process as used by Post, contact Mr. Will Tanner, Post Division of General Foods, 275 Cliff Street, Battle Creek, Michigan, 49015.

11. Letterpress - Erasable Overlay.

Another novel approach in providing feedback is by overlaying the feedback information with an erasable material. This is a relatively expensive process due to the number of steps involved. First, the basic information relative to the item number and all the feedback information is printed by letterpress or offset. The second run is an application of plastic or varnish over the feedback information. One processor claims that more than one coat of protective material is required. Then, an overlay coating of ink is applied on top of the plastic coating which is removable by rubbing with a standard pencil. Most specialty printers can develop the process. The process is irreversible. (See Figure 7.)

Patented materials are available from Van Valkenburgh, Nooger and Neville, Inc., 15 Maiden Lane, New York 38, New York. A second source of information is Mr. L. L. Balsley, Data-Design Laboratories, 945 East California Street, Ontario, California, 91726. The latter organization applies this process to their military training programs.

12. Letterpress/Offset - Magnetically (attractive or repulsive) Activated Feedback.

Under subcontract to SWRL a Harvey Mudd Engineering Research team investigated the use of ferric inks in feedback systems. A pencil-like, hand-held magnet was designed to sense the presence of iron suspended in ink. The system did not work effectively until the response positions containing the ferric inks were precut on three sides like a tab. When this was done the appropriate tab moved up in response to the magnet and tabs with plain black ink remained stationary. The economics of this

solution do not seem to justify it over other solutions such as electrical or fluorescent feedback. Two special printing operations are required: one, the printing with special magnetic ink and the second, the cutting of the tabs. It would seem to be limited to multiple choice type responses. It would be reuseable for a limited number of times.

13. Letterpress/Offset - Fluorescent Activation of Feedback.

In subcontract to SWRL the Harvey Mudd College of Engineering research team also investigated the concept of using invisible inks containing fluorescent materials. A hand-held black light source (adapted from uranium prospecting) was used to illuminate the latent images on the page. The technical feasibility of this feedback system was proved. It has the same latitude of feedback potential as the latent image systems discussed under spirit duplication and letterpress. However, this system has a greater potential in that it is reusable. In addition, it eliminates cues produced by the responses made by previous users. The inks are commercially available. Braden-Sutphin Ink Company, 3650 East 93rd Street, Cleveland 5, Ohio, has an ink # Z-285 (OZ-220) which is quite acceptible when printed on paper with a yellowish cast to mask the slight yellow cast due to the latent image. Contact Mr. Marshfield at Braden-Sutphin for further information on the ink. An effective design of a hand-held probe is not commercially available.

This system shows great potential for application to bound instructional materials, and the generation of an effective probe should be pursued.

14. Letterpress/Offset - Absorbent White Ink on White.

It is conceivable that a latent image could be printed by either water absorbent inks or chemically reactive inks that would release either the moisture or the chemical after a short period and return to the initial state. One could probably process the information in reverse order by applying the absorbent ink or chemically reactive ink first, then applying a varnish or water proofing agent to all but the latent image area. In either case the difference in reflectivity in the image areas before use is a measure of the cueing to the student. This difference would have to be zero. The reaction time to the water or chemical must be less than one-half second to be effective. Further, there must be an adequate change in appearance due to water absorption. Since the reaction would be partially under the control of the student in either the pressure with which he applied the water or chemical as well as the speed with which he stroked his writing instrument, progressive revelation of the latent image would be an incentive for the student to continue at the task.

There are no known sources for this technique at this time.

15. Letterpress - Mechanical - Prepunched response forms.

Self-scoring response forms designed by Professor Lew Aukes at the University of Illinois, for use at the college level, require a punching (pressing) response by the student. The answer form is a multi-laminated card incorporating three or four layers. The top sheet provides the four multiple choices, A, B, C, D, for each of 100 items in four columns of 25 each. Each choice is precut to assist the student in punching thru the laminated card with a pencil. The directions to the task are as follows: "With a pencil point punch through the response tab where you think the correct answer is. A red tab means a right answer and a white tab means a wrong answer. If you punch a wrong answer and your instructor wishes you to find the correct answer, continue punching until a red tab is revealed. Punch as few times as possible."

The form as designed appears to be limited to multiple choice type responses. The cost of the production tooling to provide non-standard forms would probably prohibit its use in all but high production applications. Early samples were not completely cheat proof in that by slightly bending the test card the red tab under the top sheet would show in the side cut of correct choice. This may have been corrected in newer versions.

For further information contact Professor Lew Aukes, University of Illinois, Urbana, Illinois. Telephone (217) 333-6496. For production applications the Container Corporation of America, Chicago, Illinois, will assist with price and delivery information. (See Figure 8 and 9.)

ADDITIONAL SYSTEMS

Additional system areas in which technical developments and engineering may provide innovative solutions include:

1. Letterpress: Polarized pen light source interacting with a printed polarized design.
2. Letterpress: Infra-red pen light source.
3. Letterpress: Inks warm to a thermal sensor.
4. Letterpress: Textured inks.

SUMMARY

The characteristics of the 15 systems described are summarized in the chart on the following page.

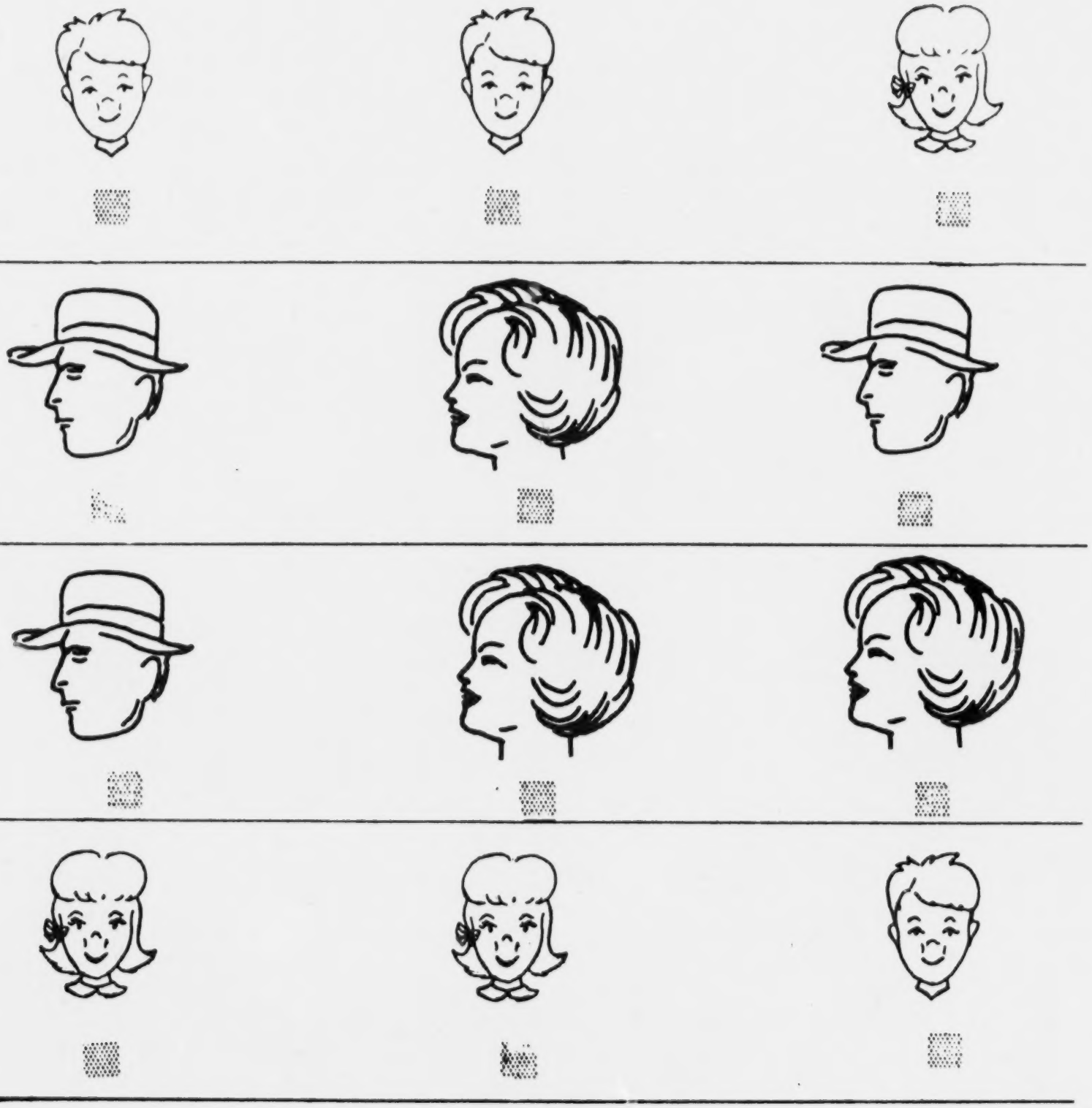
COMMENT TO READERS:

The data and descriptions presented in this technical report may be obsolete by the time this report is published, because of the innovation and product improvement by suppliers.

SUMMARY OF FEEDBACK SYSTEMS - PAPER DOMAIN

NO.	PROCESS OF REPRODUCTION	TYPE OF REACTION	REVERSIBLE OR IRREVERSIBLE	STATE OF DEVELOPMENT	NUMBER OF RUNS THRU EQUIPMENT	SPECIAL SUPPLIES REQUIRED	DESCRIPTION OF HAND HELD DEVICE	LEGAL IMPLICATION OF USE	SOURCES
1.	Mimeograph	chemical - water	Irreversible	Laboratory prototype	3	1. Special inks - anyone can compound 2. Water pens	Water filled fibre tipped pen with toxic inhibitor (Papermate Pen Co.)	NONE	NONE at present
2	Spirit duplication	Chemical	Irreversible	Laboratory prototype	1	1. Latent image masters 2. Chemical pens	Felt tipped pen filled with highly volatile chemical	OK with material procurement	A. B. Dick Co.
3.	Xerography	Mechanical - erasure	Irreversible	Directly applicable to any Model 2400	2	NONE	Standard pencil with eraser	Permission from Xerox required on leased equipment	Xerox
4.	Letterpress	Chemical - water	Irreversible	Production	3	1. Water-filled pen	Water-filled fibre tipped pen	NONE	Education Aids Publishing
5.	Letterpress	Chemical - latent	Irreversible	Production	2 (?)	Processing and pens from publishers or specialty printers	Fibre tipped pen filled with chemical	Proprietory systems	Lyons - Carnahan, Publishing Co. Appleton Century Croft Publishing Co. McGraw - Webster Publishing Co. Specialty Printers
6.	Letterpress	Mechanical - scrapeable	Irreversible	Production	3-4	NONE	1. Piece of molded plastic or 2. Any piece of metal with flat edge reasonably sharp.	Apparently standard in printing art	1. EVCO/Dorsett 2. Specialty Printers
7.	Letterpress	Mechanical - erasable	Irreversible	Production	3-4	NONE	Standard pencil with eraser	Apparently standard in printing art	Specialty Printers
8.	Letterpress	Mechanical - prepunched	Irreversible	Laboratory prototype	Proprietory	NONE	Standard pencil	Proprietory System	Container Corp. of America
9.	Letterpress	Optical - plastic	Reversible	Production	2	Plastic reader	Piece of clear plastic impregnated with color matching overlay ink	Apparently standard printing art	Specialty Printers
10.	Letterpress	Electrical	Reversible	Laboratory prototype	2	1. Conductive inks 2. Electrical sensor-penlight	Pen light with concentric contacts on tip with electronic circuit	Patented device	EVCO/Dorsett
11.	Letterpress	Mechanical - abrasive	Irreversible	Production	2	Special ink with abrasive suspended in solution	Standard graphite pencil	Apparently standard in printing art	Specialty Printers
12.	Letterpress	Chemical - pressure sensitive	Irreversible	Laboratory prototype	2	Special impregnated paper	Standard pencil/pen using blunt end	OK with material procurement	3M NCR
13.	Letterpress	Magnetic	Reversible	Conception	2	1. Special magnetic inks 2. Magnetic sensor	Standard pencil with magnetic tip over eraser	Open to printing art	OPEN
14.	Letterpress	Optical - Fluorescent	Irreversible	Conception	2	1. Special fluorescent inks 2. Fluorescent sensor	Special black light pen	Pen light yet to be patented	OPEN
15.	Letterpress	Chemical - Latent water absorption	Irreversible	Conception	2	1. Special inks 2. Water pen	Felt tipped water-filled pen with toxic inhibitor	Open to printing art	OPEN

Table 1



SELF-CORRECTING MECHANISM

Demonstration directions: Mark the picture that is different.

Figure 1

Mimeograph process with water pens

A Sample Test to Demonstrate Self-Instructional Duplicating Techniques

1. The capitol of Maine is
   /X/Augusta /___/Bangor /___/Bar Harbor /___/Portland

2. Which state does not have a border on Lake Michigan
   /___/Indiana /X/Ohio /___/Illinois /___/Wisconsin

3. The state that is adjacent to the western border of Colorado is
   /___/Nevada /___/Idaho /___/Utah /___/California

4. The largest lake in Utah is
   /___/Lake Mead /___/Great Bend /___/Lake Provo /___/Great Salt Lake

5. The body of water west of Manhattan Island is
   /___/Hudson /___/Delaware /___/East /___/Atlantic Ocean

Extra spaces for additional answer coding marks

Number 1 /___/ /___/ /___/ /___/ /___/

Number 2 /___/ /___/ /___/ /___/ /___/

Number 3 /___/ /___/ /___/ /___/ /___/

---

6. Little Rock, Arkansas is smaller than Rockford, Illinois /___/True /___/False

7. The Ohio River flows into the Mississippi River at St. Louis, Missouri /___/True /___/False

8. Idaho shares a border with Canada /___/True /___/False

9. The capitol of Kentucky is Lexington /___/True /___/False

10. Galveston, Texas is on the Gulf of Mexico /___/True /___/False

Product Planning Department
A. B. Dick Company
5700 W. Touhy Avenue
Chicago, Illinois 60648

Figure 2

Spirit duplication process with chemical pens.

I	II	III	IV
1. A B C D	1. A B C D	1. A B C D	1. A B C D
2. A B C D	2. A B C D	2. A B C D	2. A B C D
3. A B C D	3. A B C D	3. A B C D	3. A B C D
4. A B C D	4. A B C D	4. A B C D	4. A B C D
5. A B C D	5. A B C D	5. A B C D	5. A B C D
6. A B C D	6. A B C D	6. A B C D	6. A B C D
7. A B C D	7. A B C D	7. A B C D	7. A B C D
8. A B C D	8. A B C D	8. A B C D	8. A B C D
9. A B C D	9. A B C D	9. A B C D	9. A B C D
10. A B C D	10. A B C D	10. A B C D	10. A B C D
11. A B C D	11. A B C D	11. A B C D	11. A B C D
12. A B C D	12. A B C D	12. A B C D	12. A B C D
13. A B C D	13. A B C D	13. A B C D	13. A B C D
14. A B C D	14. A B C D	14. A B C D	14. A B C D
15. A B C D	15. A B C D	15. A B C D	15. A B C D
16. A B C D	16. A B C D	16. A B C D	16. A B C D
17. A B C D	17. A B C D	17. A B C D	17. A B C D
18. A B C D	18. A B C D	18. A B C D	18. A B C D
19. A B C D	19. A B C D	19. A B C D	19. A B C D
20. A B C D	20. A B C D	20. A B C D	20. A B C D
21. A B C D	21. A B C D	21. A B C D	21. A B C D
22. A B C D	22. A B C D	22. A B C D	22. A B C D
23. A B C D	23. A B C D	23. A B C D	23. A B C D
24. A B C D	24. A B C D	24. A B C D	24. A B C D
25. A B C D	25. A B C D	25. A B C D	25. A B C D

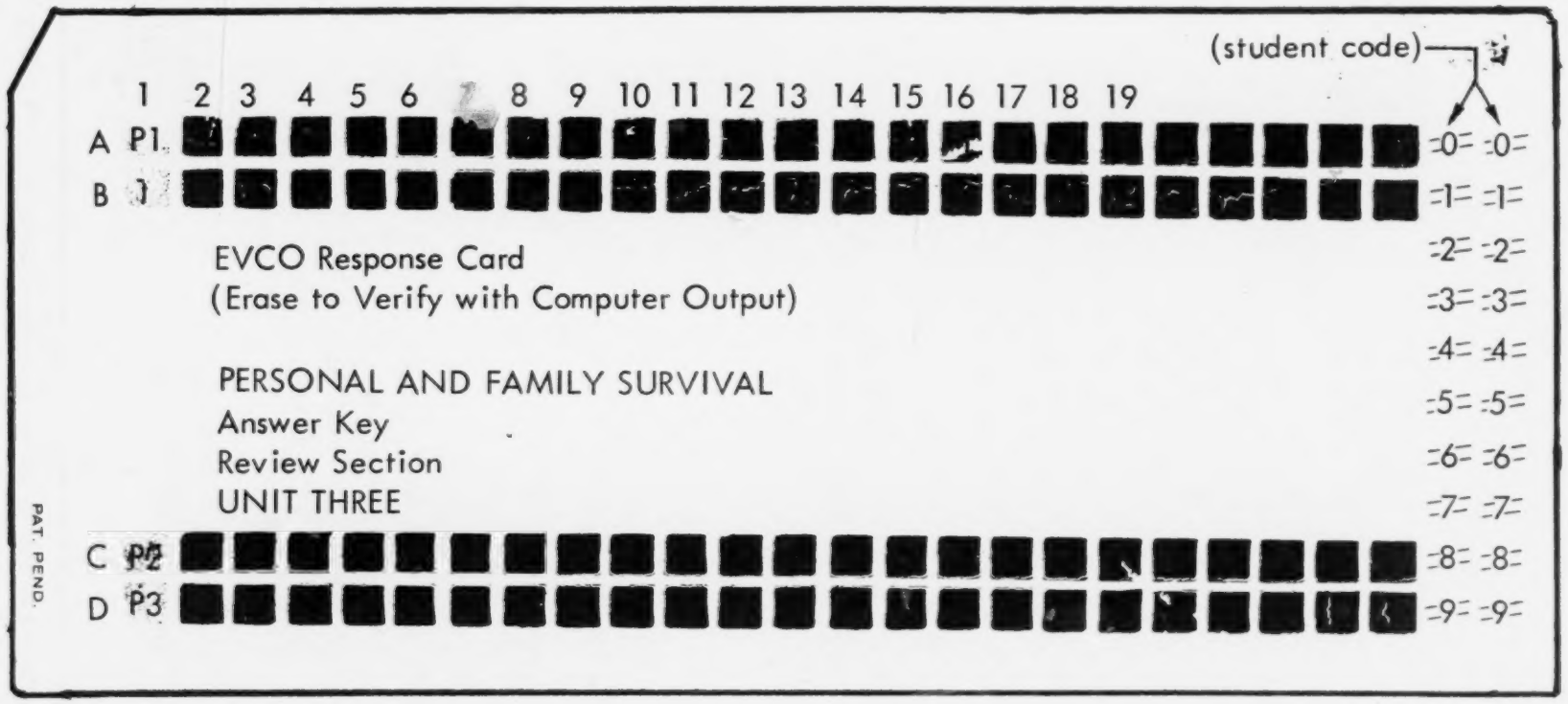
Produced By
Educational Aids Publishing Corp., Carle Place, N. Y. • Patent Pending

Figure 3

Letterpress process with water pens.
(water soluble dyes in ink)

THIS IS HOW THE EVCO CARD WORKS

(1) FEEDBACK TO THE STUDENT. First the student reads a multiple-choice item. Then he erases the block of ink over what he thinks is the answer, "A," "B," "C," or "D." If he is right he finds a "T" for True. If he is wrong he finds a number which refers him to corrective material. Thus, the first feedback loop is closed.



(2) FEEDBACK TO THE INSTRUCTOR. Then the instructor analyzes each card and is able to diagnose and remedy problems "on the spot." This closes the second feedback loop.

(3) FEEDBACK TO THE SYSTEM. Finally the card itself can be computer scored and the printout can be used to analyze the overall instructional system, thus closing the third feedback loop and providing a self-correcting instructional system.

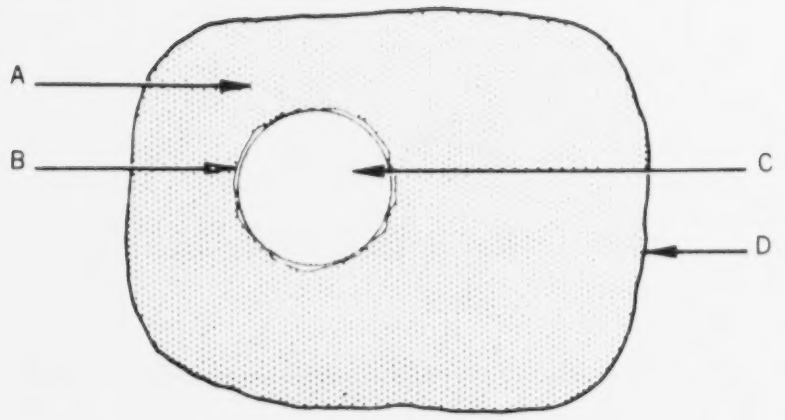
EVCO BASIC INSTRUCTIONAL RESEARCH AND DESIGN · 225 San Pedro NE · Albuquerque, New Mexico 505-256-9811

. . . AND HERE IS OUR CARD

Figure 4

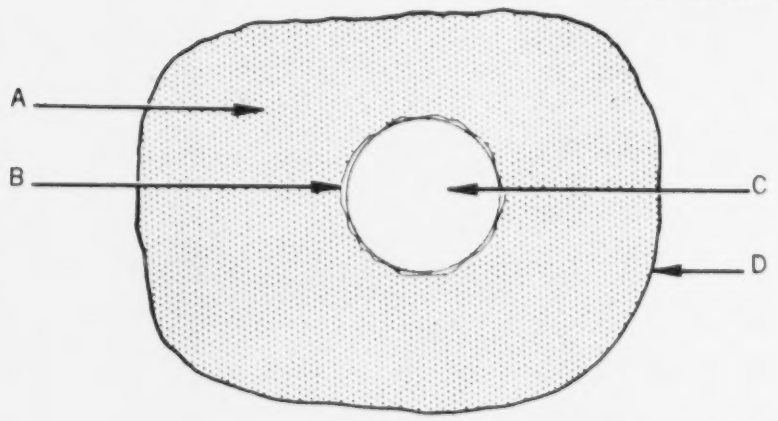
Scrapeable ink overlay process

4.



Which of the letters indicates the cell membrane?_____

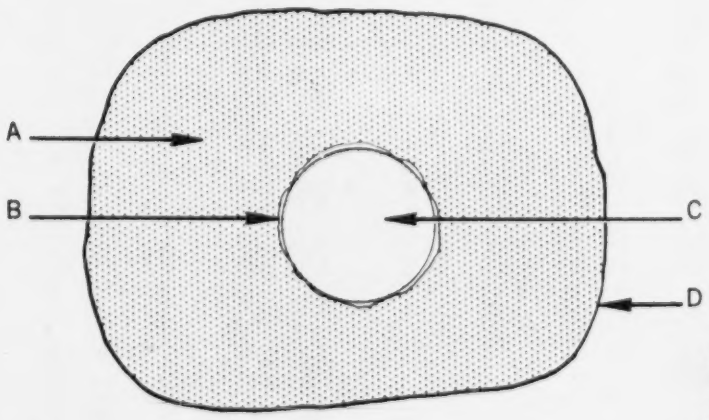
5.



The nucleus is bounded on its outside by a double-layered membrane which is referred to as the *nuclear membrane*.

Which of the letters indicates the nuclear membrane?_____

6. Label only the membrane(s) in the illustration.



A. _____
B. _____
C. _____
D. _____

Plastic overl

LITTON INSTRUCTIONAL MATERIALS, INC. A DIVISION OF LITTON INDUSTRIES
1695 WEST CRESCENT AVENUE, ANAHEIM, CALIFORNIA 92801

Figure 5
Letterpress - Overprinting Eliminated by Plastic Overlay

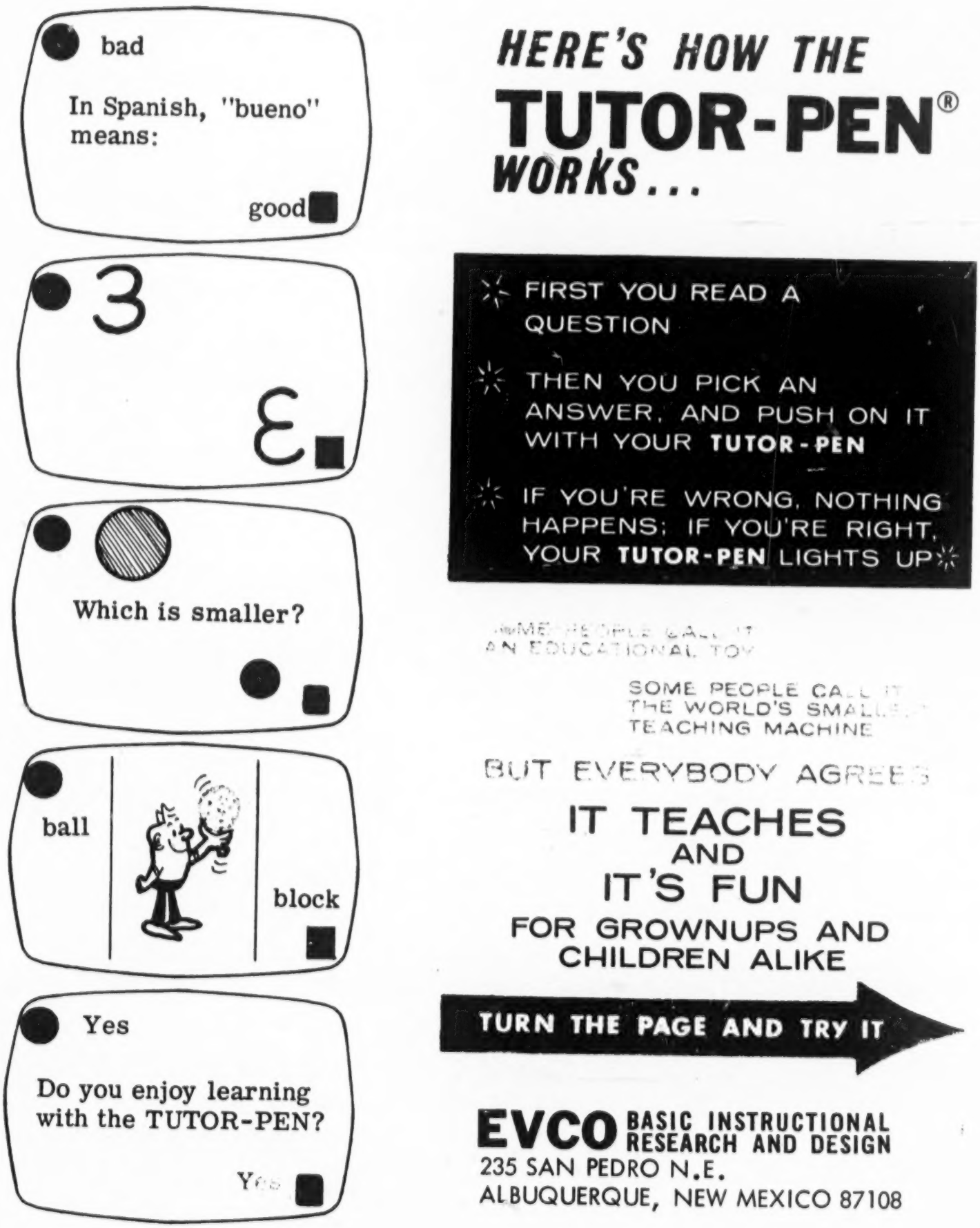


Figure 6

Letterpress - Electrically activated feedback

VAN VALKENBURGH, NOOGER & NEVILLE, INC.

NAME NORMAN CROWDER RIGHT 23/30 WRONG ____

CLASS/COURSE PSYCH. 101 MODULE/TEST NO. 4-2 SCORE C-

DATE 8/11/70 TIME 9:00-9:20 ITEMS OF DIFFICULTY 4-6-8-10

Self-Scoring TRAINER-TESTER® Response Card

PATENTED • VNN&N • TRADEMARKED

Directions—Variable Alphabetical Response Mode:
Erase the block where you think correct answer is. Preferably use clean, firm, non-plastic pencil eraser, with reasonably sharp edge. Your instructor will **designate** the **correct** answer response for a **particular** exercise, for example:

Correct Answer Designated: "T" = Right, "H" = Right etc.
Then other responses are: "H", "E" or "L" = Wrong; "T", "E" or "L" = Wrong etc.

If your instructor wishes you to learn the correct answer, continue erasing until the response designated as correct is revealed; make as few erasures as possible. For self-scoring, grading and item-of-difficulty identification see Direction Sheet.

Item of Difficulty Mark

ITEM NUMBER UNIT	ANSWER RESPONSE/ CORRECTIVE FEEDBACK (a)	(b)	(c)	(d)	SCORING POINTS
1	T				3
2				T	3
3		T			3
4			L	T	2
5	T				3
6		L	T	H	1
7			T		3
8	T	H	E		1
9	T				3
10		E	L	T	1
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					23

ITEM NUMBER UNIT	ANSWER RESPONSE/ CORRECTIVE FEEDBACK (a)	(b)	(c)	(d)	SCORING POINTS
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					

Item of Difficulty Mark

© Copyright 1966 -1969 by Van Valkenburgh, Nooger & Neville, Inc., 15 Maiden Lane, New York, N.Y. 10038 All rights reserved. Printed in U.S.A.

* U.S. Patents 2,764,821. 2,961,777. 2,980,820. 3,055,117. Patents in other English-speaking and foreign language countries issued and pending. Trademark registered in U.S. and abroad (U.S. 635,025).

T-T No. Z-11 Second Series

APR. 1969

NAME _____ GRADE OR CLASS _____ SEX _____ STUDENT NUMBER _____

TODAY'S DATE _____ COURSE _____ INSTRUCTOR _____ TEST NO. _____ KEY RED YELLOW BLACK WHITE

DIRECTIONS: Please complete the above information as directed by your instructor. This is a new type of answer sheet. Instead of just marking the answer, you will be punching the answer with your pencil. If your answer is correct, the color that has been selected as the key will appear; if an incorrect answer has been selected, a different color will appear. Hold the answer board above the level of your desk in order to punch through it correctly, but do not hold it in such a way that others may see it. When you wish to select an answer position, place your pencil point under the appropriate letter and push through firmly.

1	A	B	C	D	26	A	B	C	D	51	A	B	C	D	76	A	B	C	D
2	A	B	C	D	27	A	B	C	D	52	A	B	C	D	77	A	B	C	D
3	A	B	C	D	28	A	B	C	D	53	A	B	C	D	78	A	B	C	D
4	A	B	C	D	29	A	B	C	D	54	A	B	C	D	79	A	B	C	D
5	A	B	C	D	30	A	B	C	D	55	A	B	C	D	80	A	B	C	D
6	A	B	C	D	31	A	B	C	D	56	A	B	C	D	81	A	B	C	D
7	A	B	C	D	32	A	B	C	D	57	A	B	C	D	82	A	B	C	D
8	A	B	C	D	33	A	B	C	D	58	A	B	C	D	83	A	B	C	D
9	A	B	C	D	34	A	B	C	D	59	A	B	C	D	84	A	B	C	D
0	A	B	C	D	35	A	B	C	D	60	A	B	C	D	85	A	B	C	D
1	A	B	C	D	36	A	B	C	D	61	A	B	C	D	86	A	B	C	D
2	A	B	C	D	37	A	B	C	D	62	A	B	C	D	87	A	B	C	D
3	A	B	C	D	38	A	B	C	D	63	A	B	C	D	88	A	B	C	D
4	A	B	C	D	39	A	B	C	D	64	A	B	C	D	89	A	B	C	D
5	A	B	C	D	40	A	B	C	D	65	A	B	C	D	90	A	B	C	D
6	A	B	C	D	41	A	B	C	D	66	A	B	C	D	91	A	B	C	D
7	A	B	C	D	42	A	B	C	D	67	A	B	C	D	92	A	B	C	D
8	A	B	C	D	43	A	B	C	D	68	A	B	C	D	93	A	B	C	D
9	A	B	C	D	44	A	B	C	D	69	A	B	C	D	94	A	B	C	D
0	A	B	C	D	45	A	B	C	D	70	A	B	C	D	95	A	B	C	D
1	A	B	C	D	46	A	B	C	D	71	A	B	C	D	96	A	B	C	D
2	A	B	C	D	47	A	B	C	D	72	A	B	C	D	97	A	B	C	D
3	A	B	C	D	48	A	B	C	D	73	A	B	C	D	98	A	B	C	D
4	A	B	C	D	49	A	B	C	D	74	A	B	C	D	99	A	B	C	D
5	A	B	C	D	50	A	B	C	D	75	A	B	C	D	100	A	B	C	D

Figure 8

Letterpress - Mechanical prepunched response forms